WebKOrigen Exercises

1. Calculate and compare the Cesium inventory of a PWR, BWR and EFR after standard operation (5 cycles of 1 year, with default values).

2. What the difference of actinides toxicity (inhalation and ingestion) of a PWR running (5 cycles of 1 year) with 4% uranium enriched UOX fuel and MOX 5 years after discharge?

3. Use mode 3 to calculate the fuel inventory of a PWR (5 cycles of 1 year, 80% load factor, UOX, 4.0 enriched), 10 years after discharge. Plot the activity, toxicities and decay heat of the totals and of the individual nuclides.

4. Calculate the decay heat produced by fission products of a BWR running UOX 5 % enriched for 6 cycles of 340 days:
    a. 1 year after discharge
    b. 10 years after discharge
    c. 1000 years after discharge

5. With the use of WebKOrigen:
    a. Reproduce the Ingestion toxicity curves over 10^6 years (total, actinides, fission products) of a PWR with default inputs per tons of heavy metal.
    b. Plot the same curves with reprocessing the minor actinides (default reprocessing vector)
    c. If one takes the reference level of ingestion toxicity (7.63 tons of uranium in equilibrium, corresponding to ~2.10^5 Sv), after how long is the radiotoxicity curve reaching the reference level with and without reprocessing?
    d. How is the time scale to reach the radiotoxicity reference level changing, if Pu can be reprocessed only by 98% (instead of 99.9%)? What conclusions on high actinides waste management can you draw (reprocessing, P&T, etc…)?

6. Calculate the number of alpha particles produced in the decay of 3 g of ^{241}Am over 20 years.

7. Iodine-131, with a half-life of 8.02 days, is used in the manufacturing of radiopharmaceuticals for a variety of applications. These include diagnostic and therapeutic thyroid applications (in either a solution or capsule form), industrial tracers, and various research applications such as antibody labeling. Iodine-131 is also used to label antibodies for therapeutic applications in the treatment of cancers. I-131 is fission product of U-235, within other fission products.

I-131 is also a decay product of Te-131, which is also a fission product of U-235, as well as a decay product of Sb-131, another fission product. Te-131 can be formed by neutron capture by Te-130.

a. Calculate the production of ^{131}I present in the fuel one day after discharge for a PWR (standard input parameters) with UOX and MOX (use ingestion radiotoxicity and convert in Bq using the effective dose coefficient ingestion 2.2x10^{-8} Sv/Bq).

b. Calculate the production of ^{131}I from the neutron capture of 1 gram ^{130}Te irradiated with a thermal neutron flux of 3x10^{14} neutrons.cm^{-2}.s^{-1} (dedicated facility option) for 10 days. A cancer therapy capsule comprises about 100 mCi of radioactivity, how many capsules could one prepare in theory with 1 g of ^{130}Te after 10 days of irradiation?